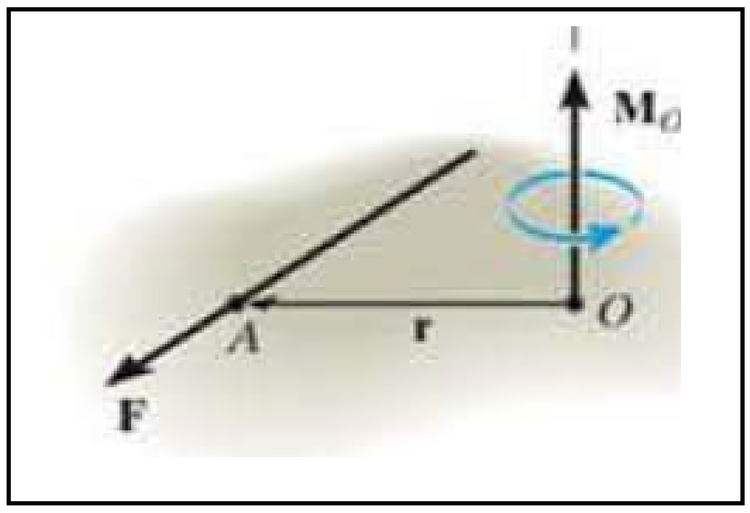
The moment about point

The moment about point can be expressed as



$$M_O = r \times F$$

Here r represent the position from the point o

to any point on the line of action of F

If $r = r_x i + r_y j + r_z k$ and $F = f_x i + f_y j + f_z k$ then,

$$\vec{M_O} = \begin{vmatrix} i & j & k \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix} = (r_y F_z - r_z F_y)\vec{i} - (r_x F_z - r_z F_x)\vec{j} + (r_x F_y - r_y F_x)\vec{k}$$

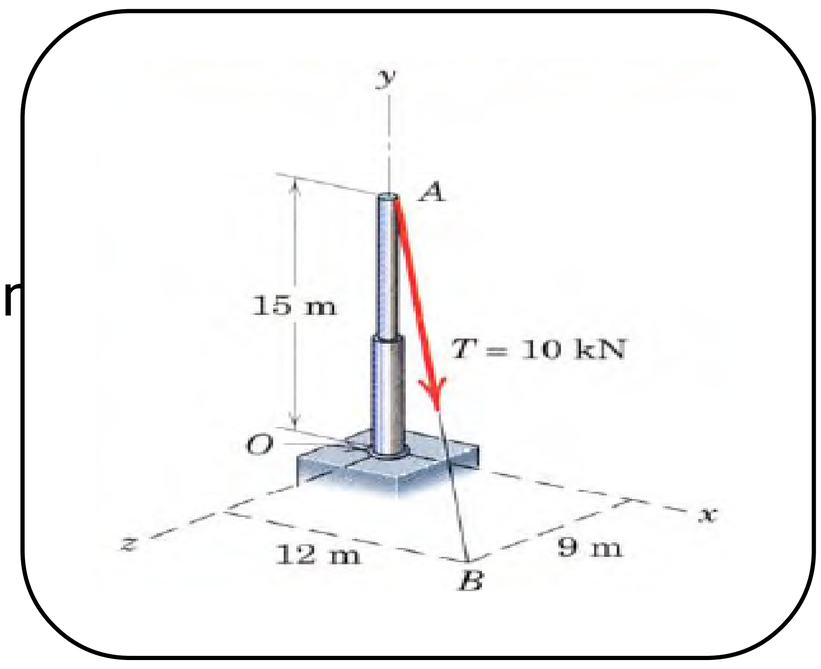
$$M_x = r_y F_z - r_z F_y \qquad M_y = r_z F_x - r_x F_z \qquad M_z = r_x F_y - r_y F_x$$

The moment about line

The moment about line is the moment about any point in the line times the unit vector for this line.

Example1

Determine the moment produced by the tensior



about point O and then find M_x, M_y and M_z

Solution

$$\vec{T} = |T|\frac{\overline{AB}}{|AB|} = 10\left[\frac{12\mathbf{i} - 15\mathbf{j} + 9\mathbf{k}}{\sqrt{(12)^2 + (-15)^2 + (9)^2}}\right]$$

$$= 10(0.566\mathbf{i} - 0.707\mathbf{j} + 0.424\mathbf{k})\ \text{kN}$$

$$\overrightarrow{M_O} = \vec{r} \times \vec{T} = \overrightarrow{oA} \times \vec{T} = 10\begin{vmatrix} i & j & k \\ 0 & 15 & 0 \\ 0.566 & -0.707 & 0.424 \end{vmatrix} = 150(0.424\vec{i} - 0.566\vec{k})$$

Ans.

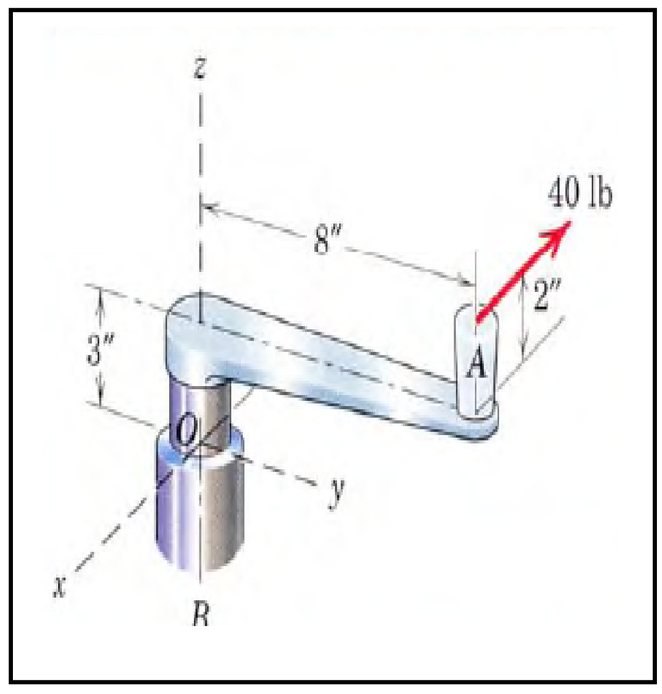
The moment about line x axis is,

$$M_x = \overline{M_O} \cdot \vec{i} = 150 * 0.424 = 63.6$$
$$M_y = \overline{M_O} \cdot \vec{j} = 0$$
$$M_z = \overline{M_O} \cdot k = 150 * -0.566 = -84.9$$

Ans.

Example 2

Find the moment of the applied force at point A about point O.



Solution

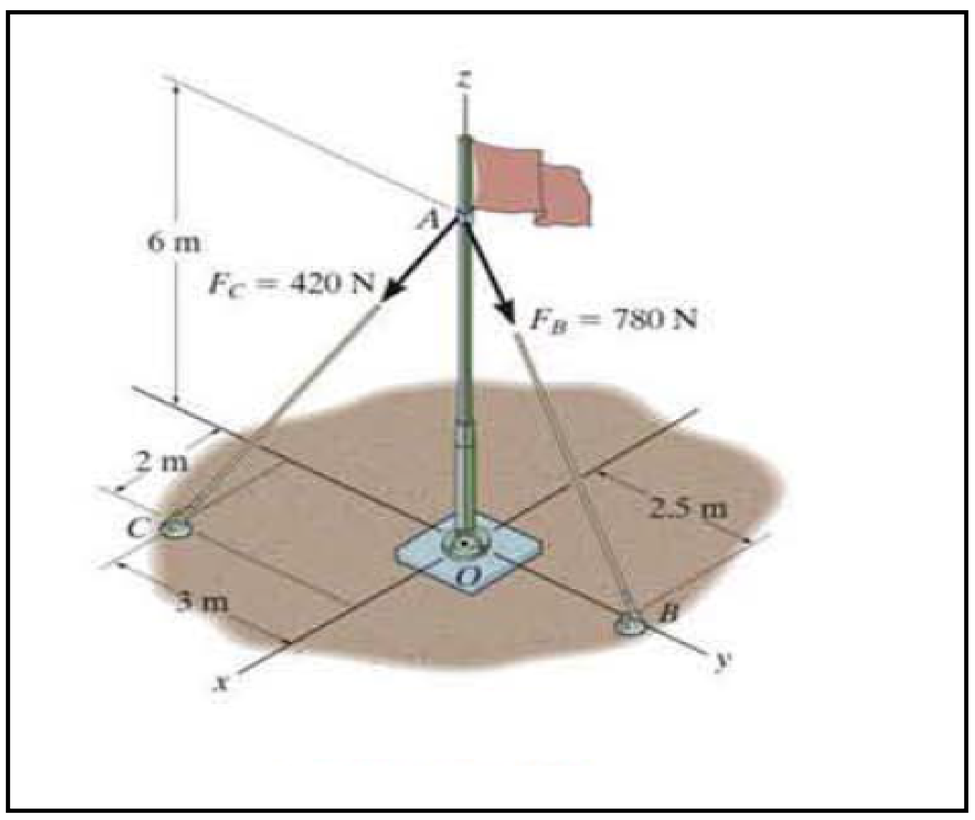
$\mathbf{r} = \overrightarrow{OA} = 8\mathbf{j} + 5\mathbf{k}$. $\mathbf{F} = -40\mathbf{i}$ lb.

$$\overrightarrow{M_O} = \vec{r} \times \vec{F} = \overrightarrow{oA} \times \vec{F} = 10\begin{vmatrix} i & j & k \\ 0 & 8 & 5 \\ -40 & 0 & 0 \end{vmatrix} = -200\vec{i} + 320\vec{k}$$

Home work

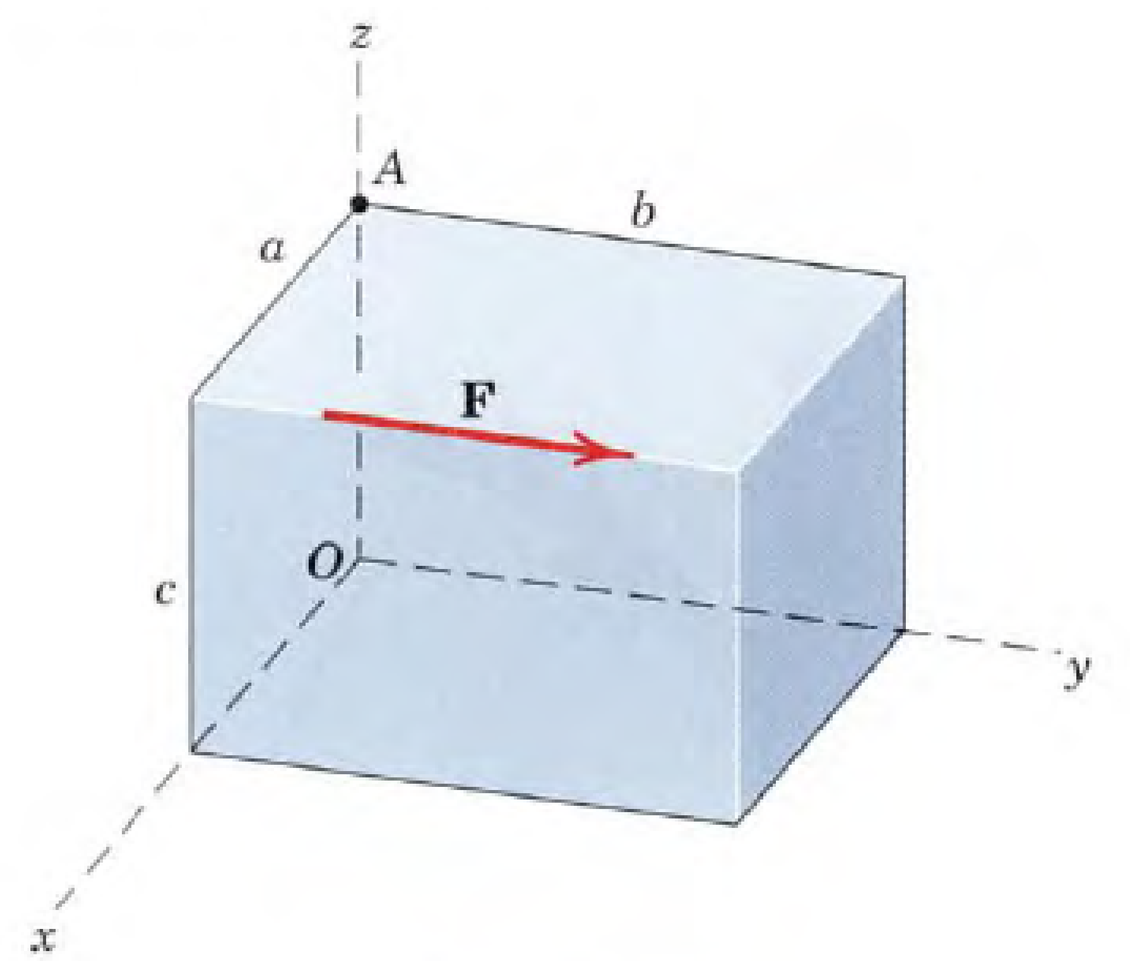
1-Find the resultant moment produced by

the two forces F_B, F_C about o.



Moments

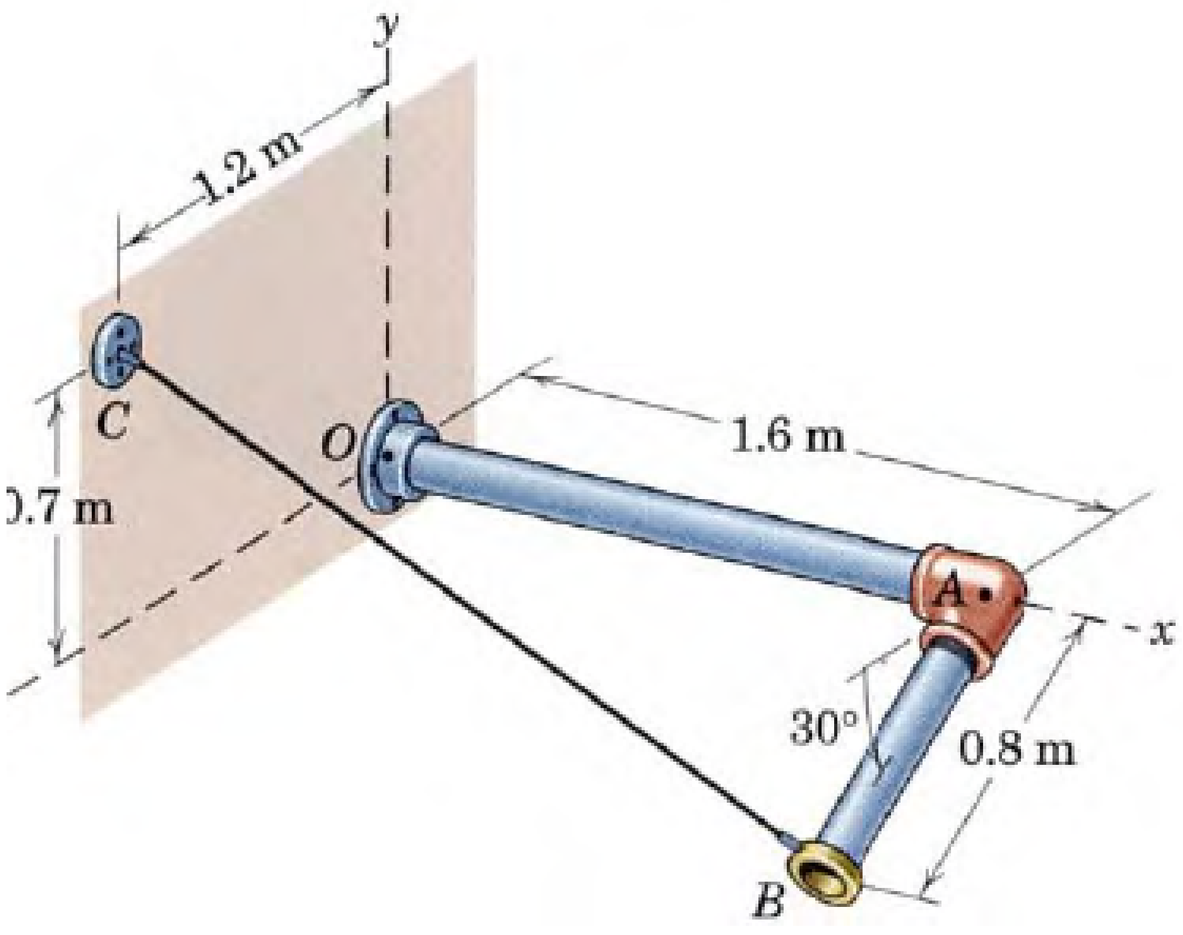
2-determine the moment of the force F about point o and about point A



3-

The cable BC carries a tension of 750 N. Write this tension as a force $\mathbf{T}$ acting on point B in terms of the unit vectors $\mathbf{i}$, $\mathbf{j}$, and $\mathbf{k}$. The elbow at A forms a right angle.

Ans. $\mathbf{T} = -598\mathbf{i} + 411\mathbf{j} + 189.5\mathbf{k}$ N



4-In the problem 3 find the moment about point o

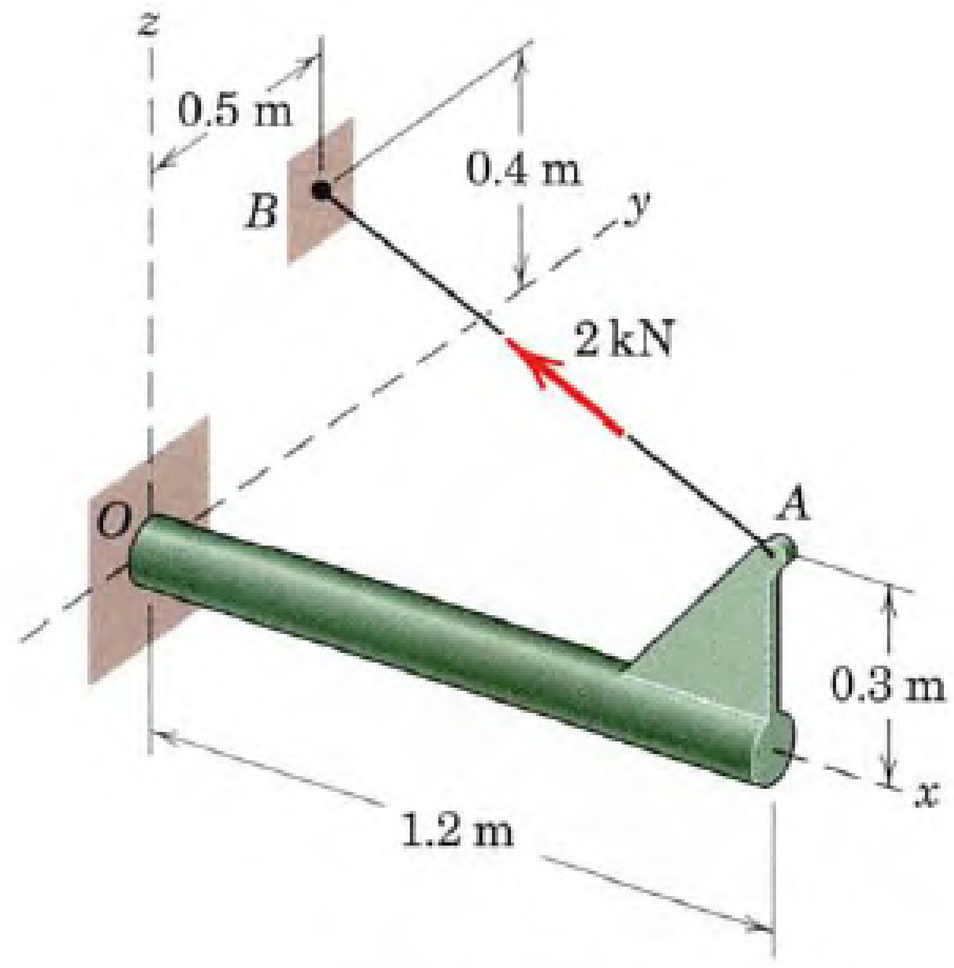
5-Determine the value of x that make

$\underline{F}_1 = x\underline{i} - 2\underline{j} + 4\underline{k}$

$F_2 = 3i + 2j - 2k$ are orthogonal.

6-

The cable exerts a tension of 2 kN on the fixed bracket at A. Write the vector expression for the tension **T**.



7- In the proplem 6 find the moment about point o.

8- what is the resultant of the forces

$\underset{\sim}{F}_1 = \underset{\sim}{6}i + \underset{\sim}{8}j$

$\underset{\sim}{F}_2 = \underset{\sim}{i} - 2\underset{\sim}{j} + 2\underset{\sim}{k}$

$F_3 = 4i + 4j - 7k$ and what is its magnitude and angles does it make with the y axis

.

9-

Find the moment of the force $F = (3i - 2j + 6k)N$ acting at $r = (2, -2)$ about the point $R = (0, 0, 7)$. Then find the moment of this force about a line through $R = (0, 0, 7)$ that making equal angles with the axes